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(54) **METHOD AND APPARATUS FOR A MULTI-MODALITY IMAGING SYSTEM**

(75) Inventors: **Leonid Yakubovsky**, Kiriat Bialik (IL); **Alexander Vaisburd**, Haifa (IL); **Yaron Hefetz**, Herzeliya (IL)

(73) Assignee: **General Electric Company**, Schenectady, NY (US)

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A47B 23/06 (2006.01)

(52) **U.S. Cl.** **600/427**; 600/425; 5/601

(58) **Field of Classification Search** 600/415, 600/407, 425, 427, 436; 378/20, 208, 209; 5/47, 601, 611

See application file for complete search history.

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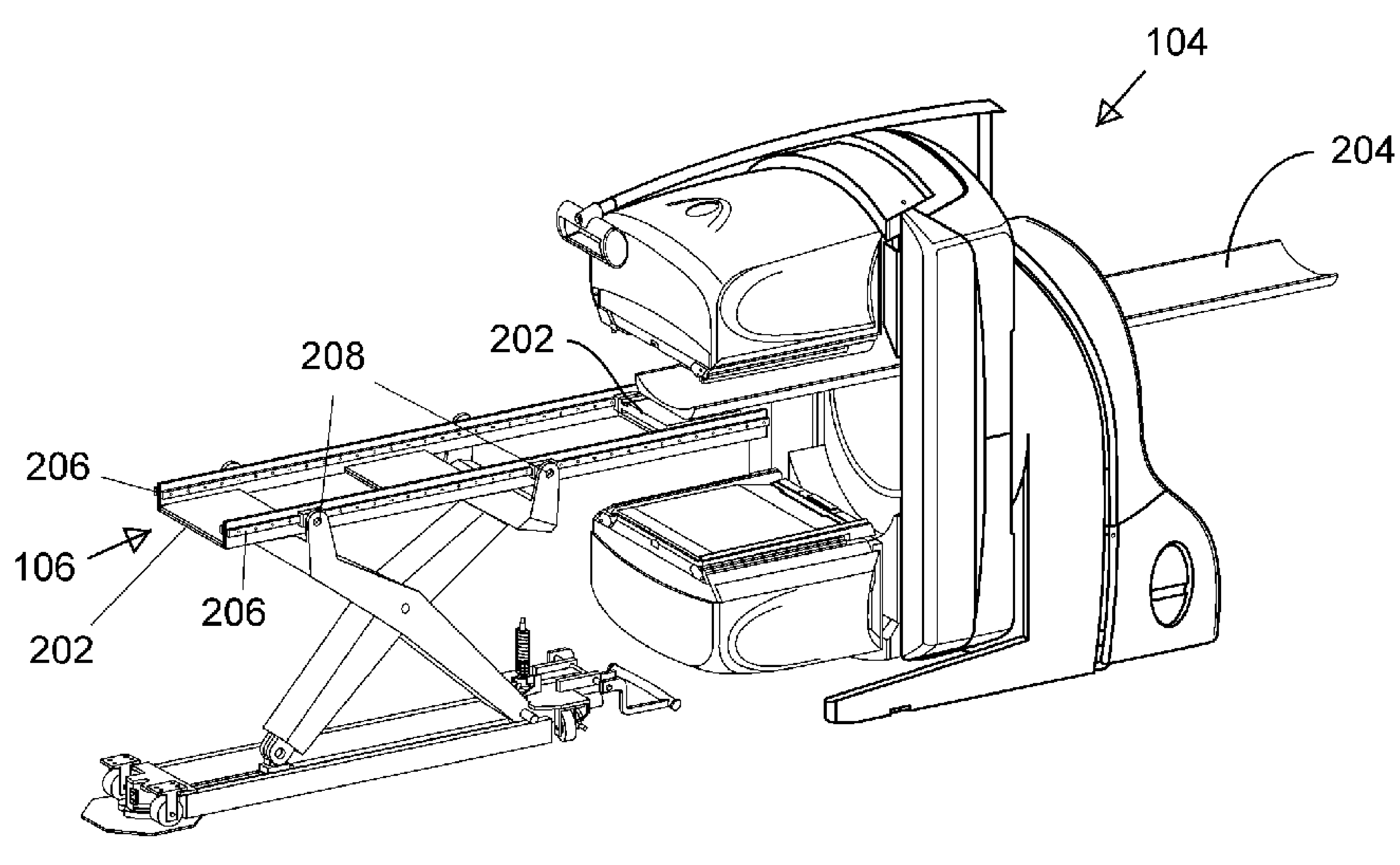
Primary Examiner — Long V. Le
Assistant Examiner — Angela M Hoffa
(74) *Attorney, Agent, or Firm* — The Small Patent Law Group; Dean D. Small

(57) **ABSTRACT**

An apparatus for examining a patient is provided. The apparatus includes a top plate, at least one top rail slideably coupled to said top plate, said top plate selectively positionable between a first imaging position and a second imaging position along an examination axis, a support member coupled to said at least one top rail, said support member configured to selectively change a position of said top plate along an axis perpendicular to said examination axis, said support member comprises at least one guide pin slideably coupled to said at least one rail during movement of said support member, said guide pin configured to retain said support member to said at least one top rail when said top rail is moved between a first modality position and a second modality position.

2 Claims, 6 Drawing Sheets



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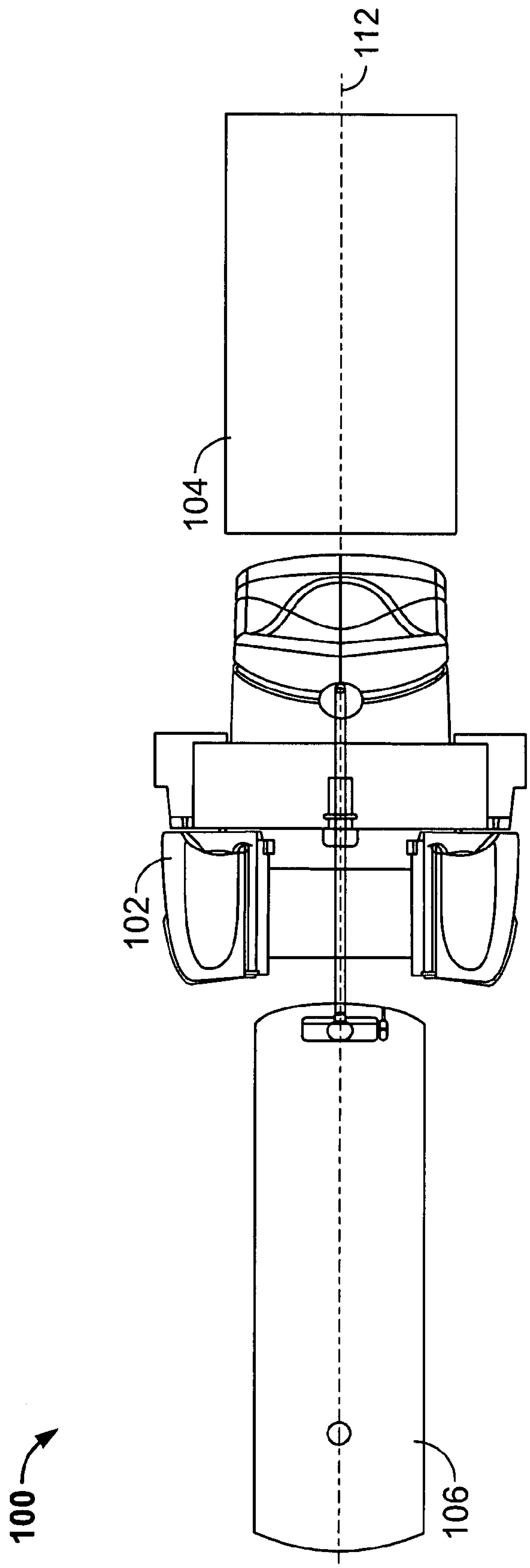

FIG. 1

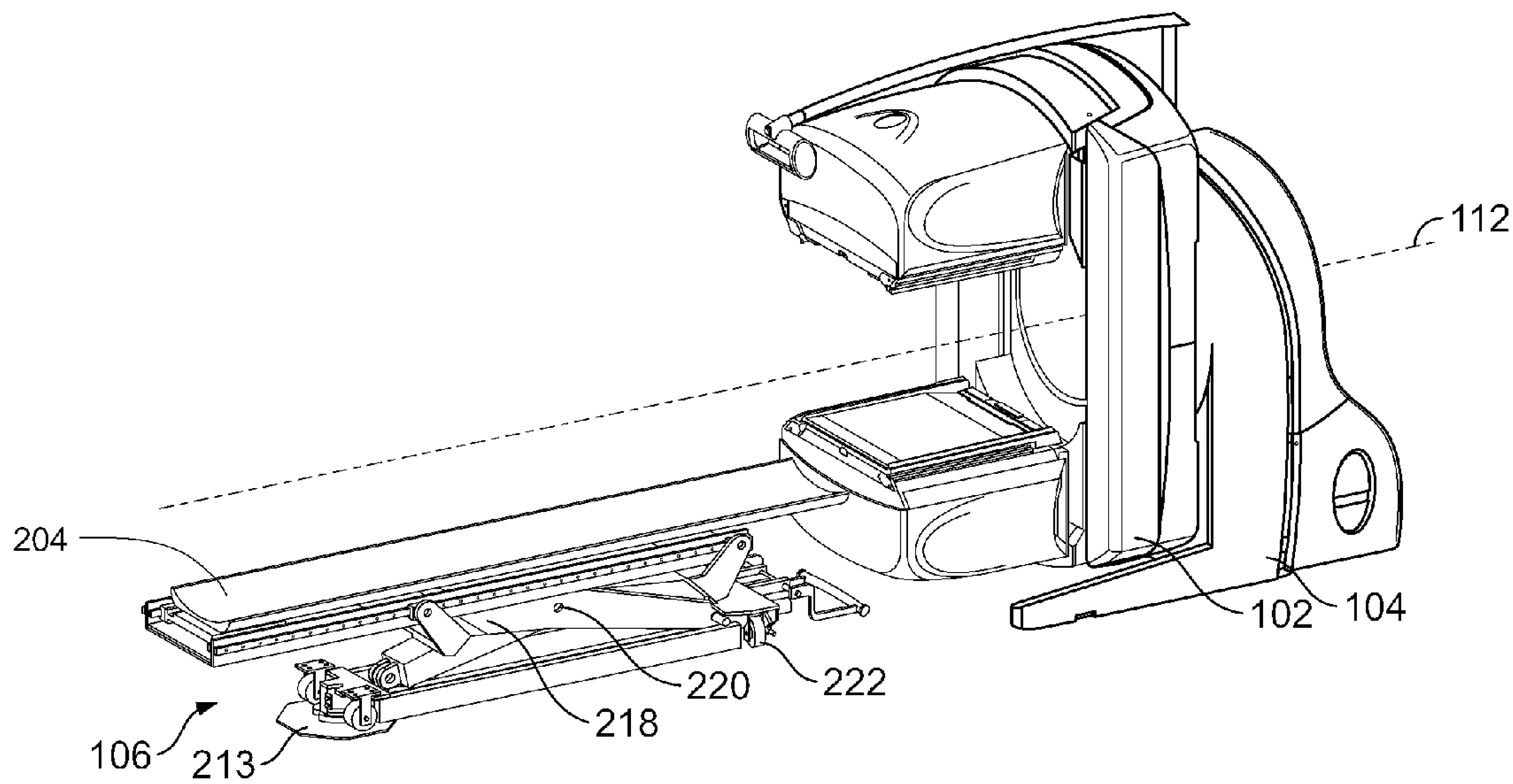

FIG. 2

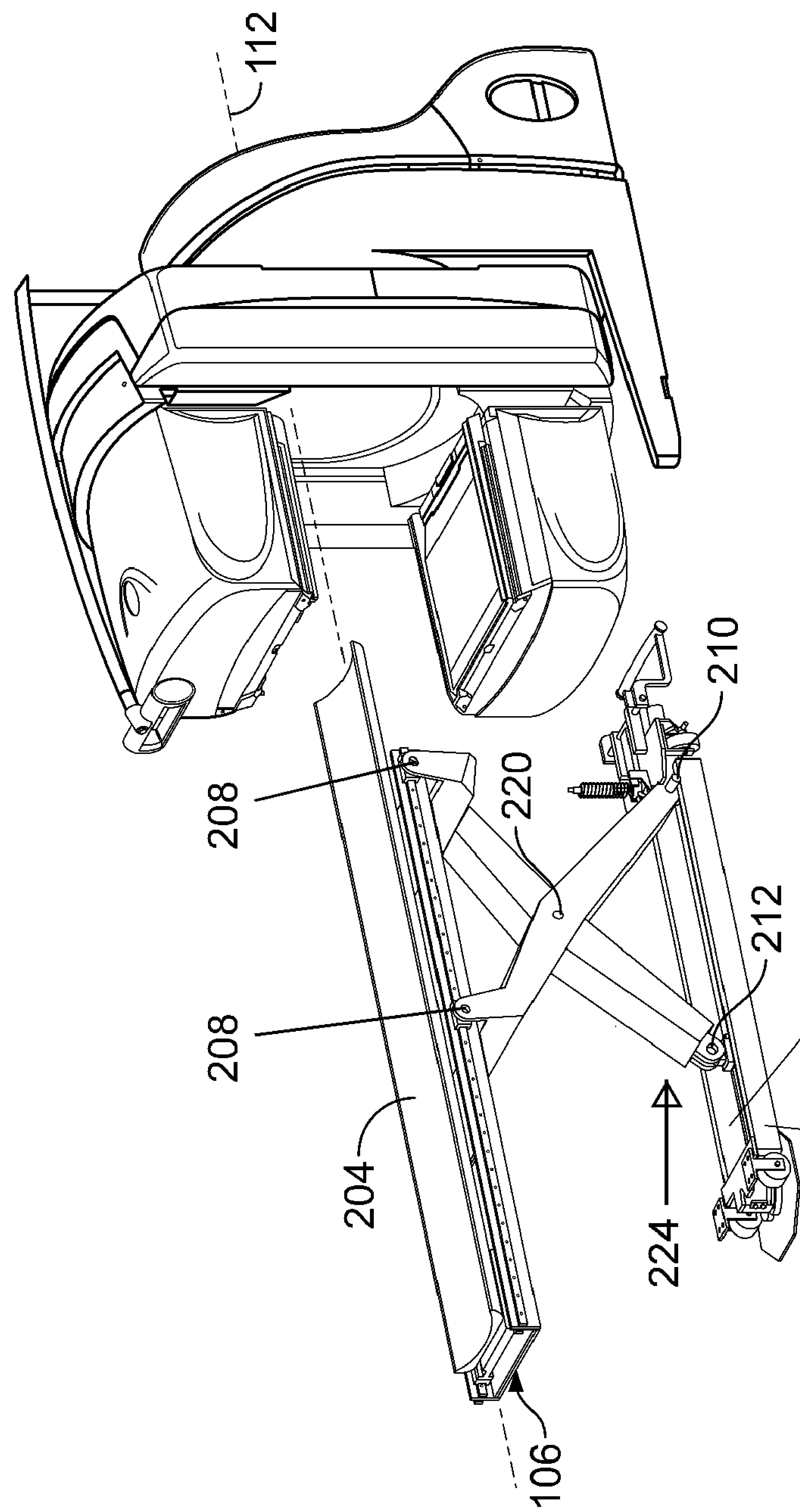

FIG. 3

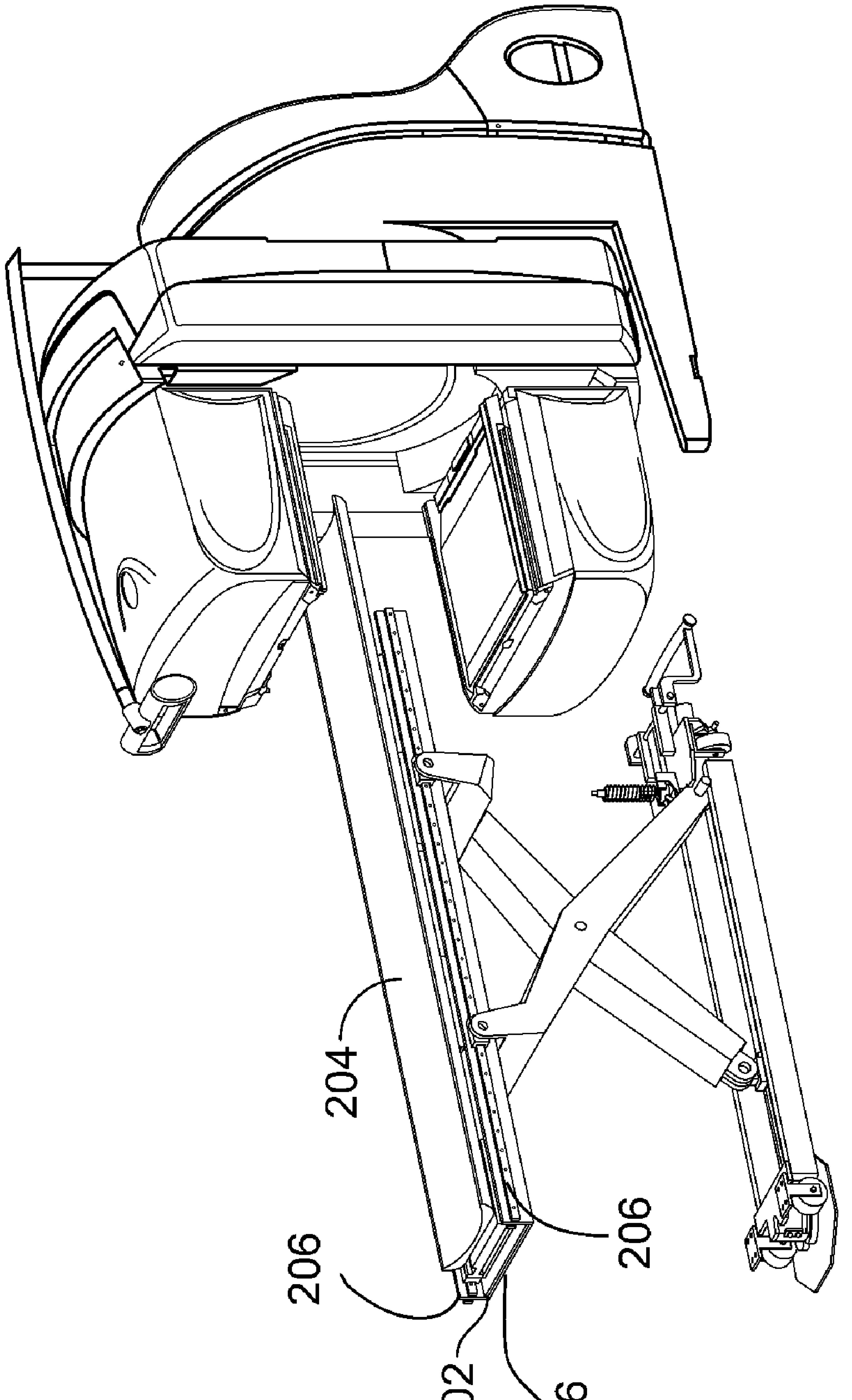

FIG. 4

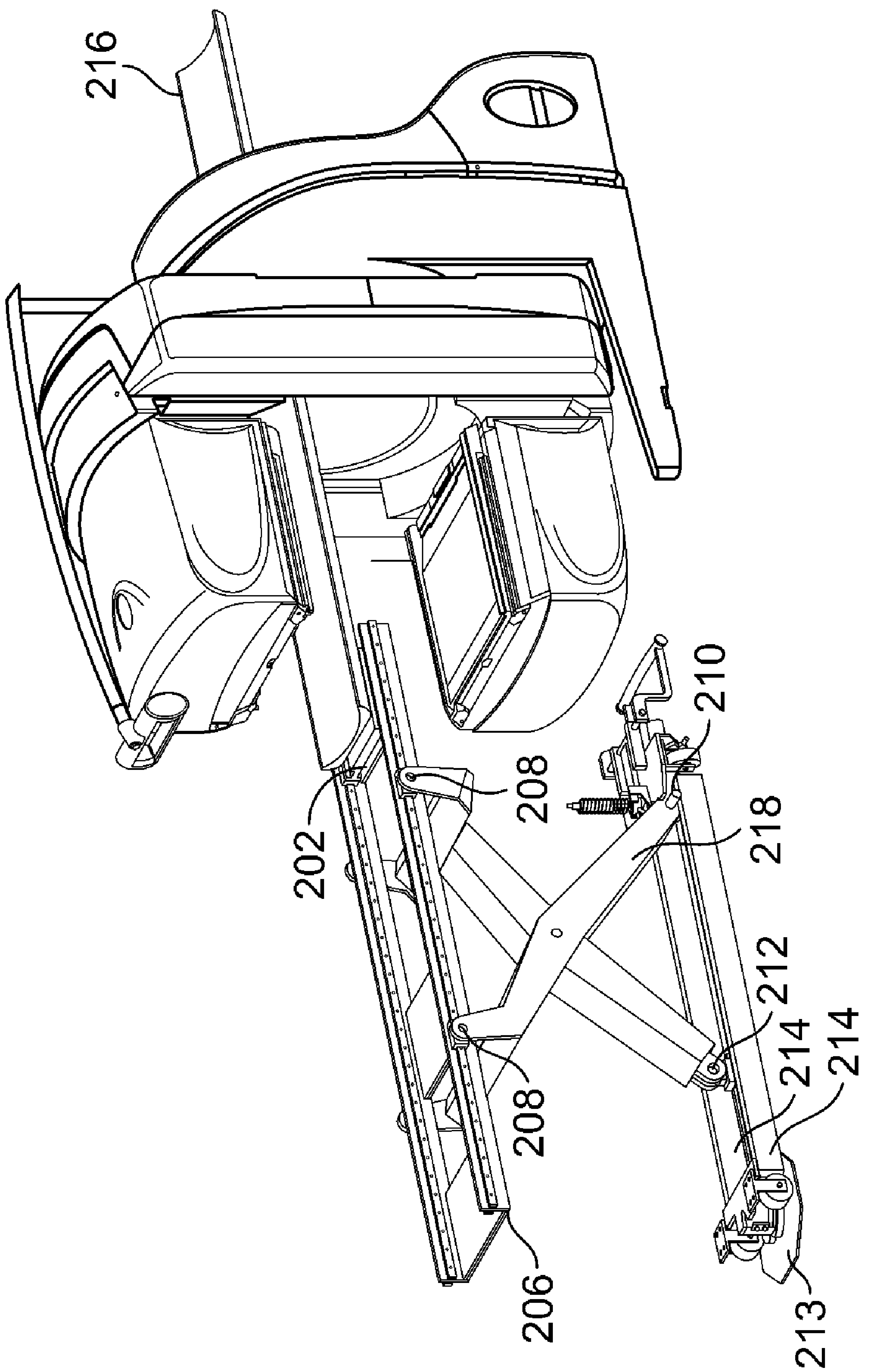

FIG. 5

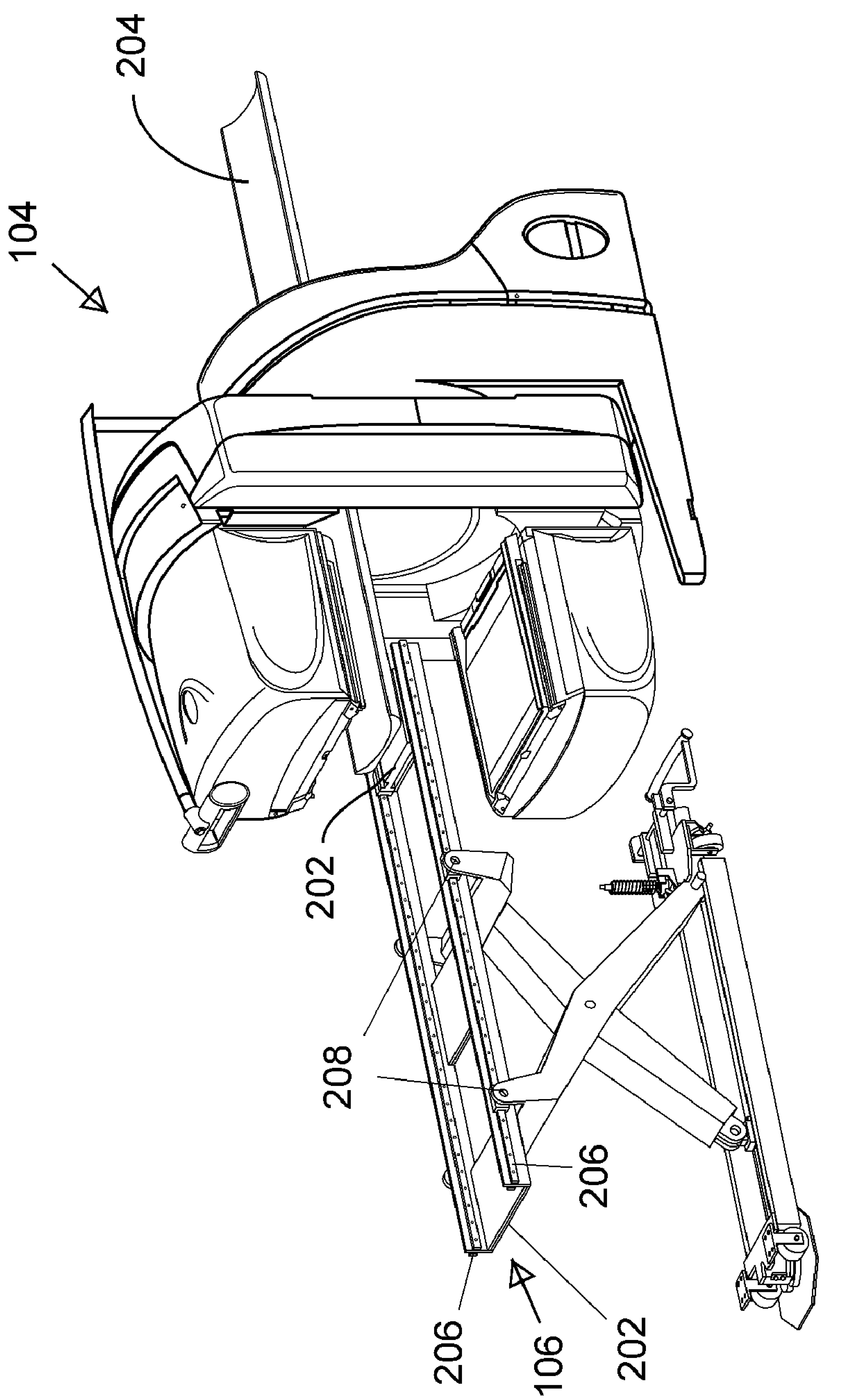

FIG. 6

METHOD AND APPARATUS FOR A MULTI-MODALITY IMAGING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally to imaging and treatment systems, and more particularly to methods and apparatus for aligning an object being scanned in multi-modality systems.

At least some multi-modality imaging and treatment systems are capable of using a combination of different modalities, such as, for example, Positron Emission Tomography (PET), Single Positron emission tomography (SPECT), Ultrasound, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Static X-Ray imaging, Dynamic (Fluoroscopy) X-Ray imaging, and radio-therapy. In a multi-modality system (sometimes referred to as a multi-modal system), a portion of the imaging hardware is utilized to perform different scans or treatments, (e.g., an image produced by SPECT is processed and displayed respectively, by the same computer and display, as an image produced by CT). However, the data acquisition systems (also referred to as an "imaging assembly") may be different. For example, on a CT/SPECT system, a radiation source and a radiation detector are used in combination to acquire CT data, while a radiopharmaceutical is typically employed in combination with a SPECT camera to acquire SPECT data.

In multi-modality systems, such as, for example, an integrated SPECT/CT system there may be an inherent registration of the SPECT and CT images the system acquires. Because the patient lies motionless on the same table during the SPECT and CT portions of the acquisition, the patient may be in a consistent position and orientation during the two acquisitions, greatly simplifying the process of correlating and combining the CT and SPECT images. This allows the CT image to be used to provide attenuation correction information for the reconstruction of the SPECT image, and allows an image reader to easily correlate the anatomic information presented in the CT image and the functional information presented in the SPECT image.

This inherent registration assumes an alignment of the SPECT and CT detector coordinate systems, or at least a known spatial transformation between the two coordinate systems. A misalignment of the coordinate systems may directly result in a misregistration of the images. Misregistration results not only in inaccurate localization, but also to incorrect attenuation correction of the functional image.

Proper SPECT and CT image registration may also require an alignment of the axial (z) axis of the SPECT and CT coordinate systems not only with each other, but also with the travel axis of the table that transports the patient between and during the SPECT and CT acquisitions. A co-axial SPECT/CT or other multi-modality system, especially for whole body scans, requires a relatively long axial travel distance to permit both imaging modalities the ability to image the region of interest. However, a patient table and table support may not be able to accommodate the alignment requirements while supporting a patient cantilevered out from the table support during an examination due to the extreme length of travel the patient table must travel to reach both imaging assemblies. For example, a co-axial imaging assembly arrangement requires a relatively long rail system, and the length of the bed may induce bending thereof, such that the patient position may change between the two imaging stations, even if the patient remains absolutely stationary.

A hospital suite may be space-limited and multiple modality systems require typically more floor space than a single-modality imaging unit. Additionally, patients preparing for the diagnostic imaging procedure must be loaded onto the table prior to the procedure, and unloaded from the table subsequent to the procedure. This loading and unloading can be difficult and uncomfortable for a patient who may have suffered recent trauma. Finally, the patient must be rigidly and accurately positioned and supported between imaging modalities and during each imaging procedure.

BRIEF DESCRIPTION OF THE INVENTION

In one embodiment an apparatus for examining a patient is provided. The apparatus includes a top plate, at least one top rail slideably coupled to the top plate, the top plate selectively positionable between a first imaging position and a second imaging position along an examination axis, a support member coupled to the at least one top rail, the support member configured to selectively change a position of the top plate along an axis perpendicular to the examination axis, the support member comprises at least one guide pin slideably coupled to the at least one rail during movement of the support member, the guide pin configured to retain the support member to the at least one top rail when the top rail is moved between a first modality position and a second modality position.

In another embodiment, an imaging system is provided. The imaging system includes a first and a second imaging assembly for obtaining medical diagnostic images of a patient for at least first and second imaging modalities, said imaging assemblies being substantially aligned along an examination axis, and a stretcher for supporting an object to be imaged, said stretcher positionable along said examination axis, said stretcher slideably coupled to a top plate, said top plate positionable in a first imaging modality position; said top plate positionable in a second imaging modality position.

In another embodiment a method of examining a patient is provided, the method comprises positioning a top plate in a first modality position, positioning the stretcher axially at a first imaging modality position, imaging the patient using a first imaging modality, positioning the top plate axially at a second imaging modality position, and imaging the patient using a second imaging modality.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic illustration of an imaging system containing both a first and a second imaging system aligned along the same imaging axis;

FIG. **2** is an exemplary embodiment of a patient table support mechanism, in fully retracted position, that may be used with the imaging system shown in FIG. **1**;

FIG. **3** is the patient table of FIG. **2**, in elevated position, ready for extension into the imaging region;

FIG. **4** is the patient table of FIG. **2** in position to conduct patient imaging using a first imaging modality; and

FIG. **5** is the patient table of FIG. **2** in position to conduct patient imaging using a second imaging modality.

FIG. **6** illustrates a range of travel of the patient table shown in FIG. **2**.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** is a schematic illustration of an exemplary embodiment of an imaging system **100**. Imaging system **100** includes a first imaging assembly **102**, a second imaging assembly **104**, a patient table assembly **106**, and a support mechanism (not shown). In the exemplary embodiment, imaging assembly **102** includes an associated examination axis **112**, which defines the imaging axis of the first and the second imaging systems. As used herein, the examination axis is referenced to a single axis used to image the patient in both imaging systems. Each of imaging assemblies **102** and **104** may be, for example, any combination of a SPECT imaging assembly, a PET imaging assembly, a MRI imaging assembly, a CT imaging assembly, a Static X-Ray imaging assembly, a Dynamic (Fluoroscopy) X-Ray imaging assembly, a NM imaging assembly, and an ultrasound imaging assembly. Imaging assemblies **102** and **104** are aligned along the same examination axis **112**.

FIG. **2** illustrates an exemplary embodiment of patient table assembly **106**, in retracted mode, prior to positional alignment of the patient table assembly **106** with examination axis **112**. Scissors legs **218**, which pivot about pivot pin **220**, are fully retracted as illustrated in FIG. **2**. Stretcher **204** is positioned optionally at an elevation best suited for patient loading to ensure patient comfort. Stretcher **204** is illustrated in its lowest elevational position but may be positioned at any elevation over its range of vertical travel for patient loading. The center of table assembly pivot **213** is positioned substantially below examination axis **112**. Table assembly pivot **213** enables table assembly **106** to pivot away from examination axis **112** in order to load a patient onto stretcher **204**. Pivoting motion of table assembly **106** is facilitated by rolling elements **222**, which pivot about a vertical axis and enable the operator to pivot the table assembly **106**. Patient loading may occur during alignment of table assembly **106** with examination axis **112**, or patient loading may occur with table assembly **106** positioned at an angle to examination axis **112**, depending on the preference of the operator and/or the patient.

FIG. **3** illustrates a position of table assembly **106** wherein a patient (not shown), positioned on stretcher **204**, is substantially aligned with examination axis **112**. Table assembly **106** is elevated by application of force **224** against slide pin **212**. Slide pin **212** is slideably engaged with bottom rails **214** to enable axial motion of slide pin **212**. Pivot pin **210** retains the assembly from moving axially during application of force **224**, hence raising the table by scissors action and pivoting about pivot pin **210** and pivot pin **220**, and sliding along guide pins **208**.

FIG. **4** illustrates a second axial position of table assembly **106**, different from that shown in FIG. **3**, in which a patient (not shown) on table assembly **106** is moved from the axial position in FIG. **3** to that shown in FIG. **4**. Table assembly **106** is positioned axially by sliding, in unison, top rails **206**, top plate **202**, and stretcher **204**. Sliding motion is along guide pins **208**. Axial location of table assembly **106** is selected such that stretcher **204** may be positioned axially, with patient (not shown) positionable such that the region of interest (ROI) for scanning of the patient may be placed in an axial location which can be scanned by first imaging modality **102**.

FIG. **5** illustrates a range of travel of stretcher **204** in the region of a first imaging modality **102**. Top plate **202** is attached to stretcher **204** and both move in unison, guided by top rails **206** which are slideably engaged with top plate **202**. Patient imaging in the axial region of first imaging modality **102** is accomplished by slideably engaging top plate **202** while a patient lies on stretcher **204**. Notably, during imaging of the patient in the region of first imaging modality **102**, imaging is accomplished by relative motion of top plate **202** and top rails **206** and top rails (**206**) remain substantially stationary.

FIG. **6** illustrates a range of travel of stretcher **204** in the region of the second imaging modality **104**. Top rails **206**, top plate **202**, and stretcher **204** are moved in unison by slideably engaging top rails **206** through guide pins **208**. Stretcher **204** is preferably fabricated from high rigidity material such as carbon fiber reinforced plastic and the like, and stretcher **204** cross section is designed to maximize its second moment of inertia. As such the sag of the patient on table assembly **106** is minimized. Stretcher **204** material is preferably substantially transparent to the passage of x-rays. Accordingly, because the gravitational sag of the patient and table assembly **106** is dominated by the mechanical characteristics of stretcher **204**, the gravitational sag is substantially the same for the configurations illustrated in both FIG. **5** and FIG. **6**. Having substantially the same sag in both axial locations, a patient will have substantially the same orientational characteristics when positioned for imaging at both the first imaging modality **102** and the second imaging modality **104**. Simple translation of table assembly **106** and patient results in substantially the same gravitational sag, hence reconciliation of results from both imaging modalities is simplified.

It is contemplated that the various embodiments of the invention may be implemented with any multi-modality imaging systems, such as, for example, but not limited to, a CT/SPECT imaging system as well as systems having currently known or later developed modalities as well as combinations, such as, for example, but not limited to, a combination SPECT/ultrasound system, a CT/MRI system, and/or a CT/NM system.

The above-described embodiments of multi-modality imaging systems provide a cost-effective and reliable means for examining a patient. Specifically, a patient may be positioned for diagnostic imaging by a first modality, then translated substantially along the imaging axis to a second imaging modality, wherein the gravitational sag of the patient is substantially the same at both axial locations. Accordingly, the multi-modality imaging systems described above provide for maintaining an accurate registration of images from separate modalities in a cost effective and reliable manner.

An exemplary embodiment of a multi-modality imaging system is described above in detail. The multi-modality imaging system components illustrated are not limited to the specific embodiments described herein, but rather, components of each multi-modality imaging system may be utilized independently and separately from other components described herein. For example, the multi-modality imaging system components described above also may be used in combination with other imaging systems.

While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.

What is claimed is:

1. A method of examining a patient, said method comprising:

aligning a pair of rails, a top plate movably coupled to the pair of rails, and a stretcher coupled to the top plate along an examination axis;

positioning the stretcher and top plate axially at a first imaging modality position by moving the stretcher and top plate along the pair of rails with the pair of rails locked in position relative to a base unit coupled to the pair of rails, wherein the stretcher and top plate are capable of sliding along said examination axis in both directions relative to the base unit;

imaging the patient using a first imaging modality unit;

moving the stretcher, the top plate, and the pair of rails axially along the examination axis until at least a portion of the stretcher and top plate are positioned at a second imaging modality position, wherein the pair of rails are capable of sliding along said examination axis in both directions relative to the base unit, wherein the first imaging modality position is at an axial distance displaced along the examination axis and the second imaging modality position is at a greater displaced distance in the axial direction along the examination axis than the first imaging modality position and a gravitational sag is substantially the same at the first and second imaging modality positions; and

imaging the patient using a second imaging modality unit.

2. A method in accordance with claim **1** wherein the stretcher is raised and lowered above a rail using a scissors linkage that is coupled between a support member and the rail, the linkage having scissors legs configured to pivot about a pivot axis.

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